'POLLUTION - WE'RE ALL RESPONSIBLE

INTRODUCTION

The Water Resources Act 1991 imposes general duties on the National Rivers Authority to exercise its powers so as to ensure as far as is practicable that water quality objectives set by the Secretary of State for the Environment are achieved at all times, and to monitor the extent of pollution in controlled waters.

The powers available to us to control pollution are set out in Part III of the Water Resources Act 1991. We are the pollution control agency for both surface water and groundwater and we regulate all discharges by a system of discharge consents.

The number of incidents of pollution reported by members of the public has been increasing for some years. A large proportion of the confirmed cases are due to accidents which could have been prevented. We try to prevent such accidents by site visits, publicity and education. We also pursue a policy of prosecuting those who cause pollution through carelessness, a failure to take advice, or by their deliberate actions.

POLLUTION - WHAT IT CAN DO

We all need water to live. Pollution destroys the purity of water and can pose a serious threat to drinking water and people coming into contact with it, such as children paddling, or canoeists. It could also be a danger to animals drinking from it.

Pollution which does not immediately kill fish can still have serious effects if it continues for any length of time. It can drive fish away, prevent successful breeding and seriously damage any fish which remain.

Apart from the plants and animals which can be seen by the naked eye, there are many very small species which are vital to the life of the river. If any of the complex components of river life are harmed the whole life cycle of the river and its inhabitants can be affected.

One gallon of oil can cover four acres of water surface and spillages of what most people would regard as harmless, such as beer, molasses and milk, can cause very serious water pollution problems.

Oxygen is also vital for life. Water dissolves oxygen from the air until it becomes saturated.

Most organic matter present in water, either in suspension or solution, is a food supply for bacteria and fungi. They multiply in proportion to the amount of organic matter available and consume oxygen. If the rate of oxygen consumption exceeds the rate at which oxygen is dissolved by the water, levels of dissolved oxygen in the water will decrease. The biochemical oxygen demand (BOD) is a measure of the oxygen demand in a river. This is a measure of how much oxygen is used up in a standard test done for five days at 20 degrees centigrade.

Anything with a high BOD, or which results in the formation of something with a high BOD, is a potential pollutant. Most organic substances have a high BOD, for example soluble carbohydrates discharged in effluent from sugar refining, breweries, paper making and milk processing.

Ammonia exerts a high oxygen demand and is also toxic. Some nitrogen compounds are converted by natural processes into organic nitrogen containing compounds with a high BOD.

To complicate the problem, nitrogenous compounds are important plant foods and provide a soup of plant nutrients in which aquatic plants grow and reproduce rapidly. The result is increased dead plant material, increased BOD and lowered dissolved oxygen levels. When most of the dissolved oxygen has been removed, oxygen is taken out of any nitrates or sulphates present. The resulting change from an aerobic to an anaerobic state produces hydrogen sulphide - the smell of stagnant water, rotten eggs and also ammonia.

In the water that runs off the land there are some substances which do not dissolve but are carried along as suspended solids. Quantities tend to be higher in winter because of higher rainfall and melting snow. Depending on the size and speed of the river, the solid particles may settle out.

All sizes of particles reduce the light penetration and, therefore, photosynthesis which in turn means slowing in the growth of plant life. Very small particles which settle on the bottom of the stream may have a blanketing effect which will prevent some bottom-dwellers from living there.

Good mixing is important to get nutrients and dissolved oxygen to all parts of the water and this is best done by fast moving, turbulent streams. Small, rapidly flowing streams are nearly always saturated with dissolved oxygen but large, slow rivers are often not.

Temperature also plays an important part in the life of a river by affecting the saturation level of dissolved oxygen. Increased water temperature stimulates fish to grow at a faster rate, but at the same time the oxygen solubility is reduced if the water temperature is raised. This means that demands for oxygen are higher when its availability is lower.

Coarse fish, such as perch, roach and chub, can withstand temperatures of up to 30 degrees centigrade but game fish, such as salmon or trout, die if the water moves outside the 5-20 degrees centigrade range.

The minimum dissolved oxygen concentration necessary to maintain fish in a healthy condition is around five parts per million. Although fish can survive in lower conditions than this, some species, such as salmon and trout, require higher levels than others. Dissolved oxygen levels lower than 2.6-3 parts per million may result in fish deaths.

A lack of dissolved oxygen means many forms of life, including fish, cannot be supported. In most severe cases of pollution all the normal animal and plant life of the river may disappear.

POLLUTION - WHAT CAUSES IT?

Pollution can happen naturally as a result of decaying plant life and impurities washed from the soil. However most pollution is man-made and comes from the community and industry around the river banks.

Man-made river pollution may result from many causes, such as industrial discharges, discharges from farms - including run-off of agricultural wastes and fertilisers, seepage from waste tips and discharges from sewers and sewage works. Pollution incidents may be accidental, deliberate, due to vandalism or to negligence.

INDUSTRIAL POLLUTION

Many industrial processes involve the use of water, a substantial proportion of which may be incorporated into the product. However there are processes which give rise to water products many of which are mixed with water. Additionally some industrial processes, more particularly power generation, involve the use of water for cooling and this may give rise to the need to dispose of large quantities of water at a higher temperature than that at which it was abstracted.

Where there are only small quantities of waste water or trade effluent, as it is often termed, it is usually practicable to discharge these into the foul sewerage system serving the local community. The effluents are then treated in admixture with domestic sewage at the sewage works prior to disposal in a watercourse. In other cases where an adequate sewage system is not available or if the volume of waste water is too great to be treated in an admixture with domestic sewage, a direct discharge from the industrial premises to a watercourse may be the only option available for disposal purposes.

Discharges to Rivers

It is an offence to make any direct discharge of industrial waste water into rivers except with the prior consent of the NRA. Control of each discharge is achieved by imposing restrictions known as consent conditions, which limit the volume and quality of the effluent. In order to comply with the quality conditions laid down in the consent, most dischargers have to treat their effluents prior to discharge, except in the case of cooling water discharges which usually have little overall impact on a river, provided adequate dilution is available. In some cases primary treatment such as settlement may suffice, but most waste waters from industry require secondary or biological treatment before being discharged to watercourses. Such treatment will normally comprise either bacteria beds (biological filters) or the activated sludge process in one of its many forms. Some industrial waste waters require more complex physico-chemical treatment before they are suitable for discharge to rivers.

Other Industrial Sources

Most of the other industrial sources of pollution arise from accidental spillages and contamination of surface water by substances such as oil. The most serious of such incidents involve the accidental leakage of substances which are toxic to aquatic life such as the metals lead, mercury, cadmium and copper and trace organics particularly chlorinated hydrocarbons such as carbon tetrachloride and pesticides.

If a discharge contains a mixture of chemicals, the toxic effect may be additive and the effect on aquatic life compounded.

Fish Farming

One form of commercial activity which has grown substantially in recent years is the farming of fish for domestic consumption.

After passing through fish ponds and raceways, the water is normally of poorer quality than when it was abstracted from the river. To satisfy the conditions set by the NRA, fish farm effluents often require pre-treatment or settlement before they are returned to the river so that organic deterioration in water

quality downstream is minimised. Furthermore, biologically active chemicals are used on fish farms to reduce disease and improve growth. The use of such chemicals is limited. Nonetheless, the NRA closely monitors the activities of fish farmers and the effects on river water in much the same way as industrial dischargers.

POLLUTION BY OIL

Pollution of water by oil is a common occurrence in the United Kingdom.

"Oil" is a general term used to describe a number of hydrocarbons which are largely immiscible with water and float on its surface. Those most commonly encountered in the environment are central heating oil, waste oils from vehicles and petrol. Occasionally pollution by aviation spirit, paraffin or white spirit occurs. Oil forms a film on the surface of rivers and lakes, and may, in sufficient quantity, reduce the ability of water to take oxygen from the atmosphere. Wildfowl and other birds living in or near water can be severely contaminated and may damage their digestive tracts as a result of preening. Oil may also result in plants becoming coated so as to impair their ability to respire and photosynthesize. A small proportion of the oil may mix directly with water and have a direct toxic effect on aquatic organisms. It can also render rivers unusable for livestock watering.

Dealing with Oil Spills

On inland waters, the National Rivers Authority is responsible for dealing with oil pollution incidents. In coastal waters, the County Council Pollution Officer is responsible for carrying out remedial work whilst the National Rivers Authority has a general duty within the 3 mile limit to oversee remedial works and within these limits the National Rivers Authority can prosecute for pollution emanating from land based installations. In addition, the Port or Harbour Authorities have powers under the Prevention of Oil Pollution Act (1971) in their areas of responsibility. Oil spillages from vessels are the responsibility of the Department of Trade.

Techniques for dealing with oil spills depend on the character of the lake or watercourse into which oil has been spilled. In tidal waters, oil dispersants are exclusively used subject to MAFF approval but are not normally suitable for use in inland watercourses or near shellfish beds, because they are to some extent toxic to aquatic life. Unlike most other pollutants, oil floats and clearance methods from lakes and non-tidal watercourses take advantage of this property.

Booms are used to contain the oil which is then removed using a vacuum tanker or can be selectively absorbed by materials which are available from specialist manufacturers. Once removed, the oil is usually disposed of by incineration.

Causes of Oil Pollution

The causes of oil pollution incidents are many and varied. A significant proportion arise from the unsatisfactory storage of oil in above-ground tanks used for heating or fuelling of vehicles and from the ancillary pipework. The filling of such storage tanks, their inadequate bunding and fractures in underground pipelines are causes of oil pollution. Accidents involving vehicles carrying hydrocarbons are another source of oil pollution. These incidents can involve substantial quantities of oil in circumstances where control and handling is difficult. Oil from contaminated areas of hard-

standing, car parks and industrial estates can be minimised by the provision of a suitably designed oil interceptor in the drainage system.

Such interceptors comprise 2 or 3 chambers with dip-pipes which separate and contain oil on the surface. This may then be removed by suction tanker at suitable intervals. Modern designs of interceptor incorporate a by-pass facility which passes high flows direct to the receiving watercourse but retain oil in the installation. This avoids the flushing out of oil from the conventional design interceptor during rainstorms.

From time to time, petrol spillages occur but the main danger associated with such incidents is that of explosion and fires in drains or sewers into which it may gain access. In watercourses, petrol quickly evaporates and does not usually present a long-term danger to aquatic life.

FARM POLLUTION

Dairy Farming

Dairy farms are traditionally regarded as being the most likely sources of pollution from agricultural activities. They tend to use larger volumes of water than other farming enterprises and produce large amounts of polluting organic waste. This is mainly in the form of slurry derived from the washing down of milking parlours. This slurry is some 100 times stronger than domestic sewage and, comparatively, a 100 herd of dairy cows is the equivalent of a large village of some 400 houses in terms of organic waste produced. As surface water from roofs and yards is often not properly separated from the slurry, the volume of waste to be handled is substantially greater and the problem of dealing with the slurry exacerbated. Farmers are usually recommended to contain the slurry in above ground storage tanks or lagoons with a minimum capacity to take the volume of waste generated over four months. In summer, slurry can be spread on to the land by means of low volume irrigation systems. If storage systems fail or if the appropriate safeguards are not taken when spreading slurry, the effects on receiving watercourses can be catastrophic.

Pig Farming

Pig farms produce highly organic waste in much the same way as dairy farms. An additional complication is that piggeries are often set up on very small holdings of land and without an adequate area on which to spread waste arising from the enterprise. In addition, pigs are fed with copper additives to increase the weight of stock and care has to be exercised in the disposal of this waste since copper is toxic to aquatic life.

Other Farming Enterprises

Beef herds and poultry houses are not regarded as posing such a grave risk to the aquatic environment as other farming enterprises. However, care must be exercised in the disposal of bedding and litter and this must be carried out as far away as possible from watercourses.

Silage Production

Silage is a form of wilted and fermented grass which is stored and used as winter feed for cattle. The grass is cut in the late spring and early summer and should be allowed to wilt in the field. It is then taken to a silage

clamp where it is compressed and covered over while fermentation takes place. If the grass is allowed insufficient time to wilt in the fields, the volume of silage liquor is greatly increased.

Silage liquor is one of the most polluting farm wastes encountered and can be up to 3,000 times stronger than domestic sewage and equivalent to the sewage generated from a large town. When discharged into a stream, the liquor is lethal to fish and other aquatic life. It is important, therefore, that farmers are made aware of the strength of this waste, the silage is stored safely and any liquor draining from it is collected in a watertight tank. An additional problem is that silage liquor is highly corrosive and can damage storage facilities and equipment. The liquor is best disposed of by spreading it, usually diluted with other farm wastes, onto the land away from watercourses.

Agrochemicals and Fertilisers

Excessive use of chemical fertilisers can give rise to increases in nutrients such as nitrogen and phosphorus in rivers and lakes. This can result in eutrophication and to increased nitrate concentrations in groundwater, prejudicing the use of such waters for potable supply.

So far as agrochemicals are concerned, the Control of Pesticides Regulations 1986 made under the Food and Environmental Protection Act 1985 have brought in much stricter handling practices and HM Government has drawn up a code of practice for users to comply with. Failure to comply is admissible evidence in legal proceedings.

Good Agricultural Practice

The Code of Good Agricultural Practice lays down a framework within which farmers should be able to run their enterprises without conflict with the environment. Furthermore MAFF has increased Grant Aid under the Farm & Conservation Grant Scheme for the installation of pollution prevention measures to 50% of their cost. Farmers are encouraged to consult their advisory service (ADAS) over suitable schemes which have to be approved by ADAS in liaison with the NRA.

IN THE PAST

Fortunately, the days when rivers were covered in thick blankets of deadly foam are largely past. The foam resulted from the early soapless 'hard' detergents which were not biodegradable - that is, capable of being broken down by bacteria. Affected rivers suffered a reduction in dissolved oxygen levels and the amount of light entering the water was severely reduced. Because plant life cannot flourish without light, the food chain fails and so does the river's life. Ordinary soaps are made of natural substances (vegetable oils or animal fats) which bacteria can rapidly feed on and break down. Modern 'soft' synthetic detergents can also be broken down by bacteria. However, both can still cause a depletion of oxygen as the bacteria break them down.

Britain's industrial decline has had a large effect on improving river quality by reducing the industrial discharges from heavy industry which were so damaging. Old style coal-gas works were major polluters, but have now been made redundant by North Sea gas.

POLLUTION - THE NATIONAL RIVERS AUTHORITY'S JOB

The NRA was set up in September 1989 to protect and improve the water environment. The control and prevention of pollution is a major part of our duties. We monitor river water to help us in improving or maintaining its quality and readily give pollution prevention advice to farmers and industrialists.

Many types of pollution cannot be seen with the naked eye so samples of river water are regularly taken and analysed. Chemical analysis of water by laboratories will show the quality of the water at the time of sampling, but may miss any pollution which occurs at other times.

Pollution changes the flora and fauna which would normally be found in unpolluted rivers and different groups of aquatic plants and animals vary in their degrees of resistance to pollution. Each species has a narrow range of environmental conditions which best suit it; biological studies of organisms therefore provide quite accurate information about the condition of a river. A biological survey shows if pollution has occurred continually or intermittently during preceding months.

The fish life inhabiting particular stretches of water are also regularly examined since the numbers, condition and type of fish, may show the state of the water and tell if it is improving or deteriorating in quality.

When pollution is discovered we take steps to discover the source, stop it and where possible, remove the pollution. Legal action may be taken against people causing pollution and the costs of any cleaning-up exercise recovered. What form the pollution takes determines the action taken to remove it. Oil is contained by booms or baffles. Suction hoses or specially designed absorbent materials are used to draw the oil off the water. A strong pollutant, such as silage liquor, reduces oxygen levels in water. When this happens an aerator may be used to replace the dissolved oxygen.

Downstream users of river water are informed of a pollution incident that may affect them, particularly if water supply, spray irrigation or cattle watering are involved.

Dischargers of trade and sewage effluent must have our permission to do so. We set quality and quantity standards that the dischargers must meet which ensure that they will not harm the river. Samples are regularly taken and analysed to make sure that the standards are being met. If they are not then we may prosecute.

POLLUTION - WHAT TO LOOK FOR

Study the stream and its banks under various conditions so that you know its normal appearance at all times.

Any changes, such as an alteration in the colour of the water, an increase in cloudiness or signs of a film on the surface should be noted. It is also worth noting changes in the smell of the water since this can also be an indication of pollution.

Changes in the type, distribution and quality of plant growth are often due to a change in water quality.

Any signs of distress or change in the normal behaviour pattern of fish can warn of pollution before it becomes serious enough to kill them. Look for: fish gasping near the surface, sudden movement - including jumping out of the water, swimming slowly on their sides, stunted growth or patches of skin infection - they may be an indication of pollution.

Foam patches on water may be a sign of pollution from farm or factory drainage. Heavy foaming is serious since it may be a sign of major pollution. However, foam patches downstream of a weir or other turbulent water is not always a sign of pollution. Peaty waters can give this effect and some streams, at times of high flow, may produce foam patches because of natural run-off from the land.

If fish are found dead, dying or in distress, it is important to discover the source of the pollution as soon as possible. Contact the National Rivers Authority's nearest pollution control office immediately if you suspect a river or stream is polluted.

POLLUTION - HOW CAN YOU HELP?

Some of the complaints of pollution are ill-founded, some trivial and others are serious and need urgent attention. Until we arrive at the scene we cannot be sure which it is going to be but we would rather have 20 calls about a suspected pollution incident than none at all.

Weather conditions and time of day or night sometimes make it difficult to trace a pollution incident back to its source. After you have contacted one of our pollution control offices you could help by getting a camera and tracing the pollution back to its source, taking photographs as you go.

You can also help in the fight against pollution by remembering the following points:-

DON'T put oil, petrol or garden chemicals down drains or into gutters;

DON'T throw rubbish into rivers or streams, however large or small;

DON'T allow any potentially polluting matter to escape into a watercourse;

DO ask us for advice if you are not sure how to dispose of a potential pollutant;

DO report any suspected pollution incident immediately;

DO tell us if you have a spillage of a potential pollutant.

BATHING WATER QUALITY

Legislation

Along the 5,200 km of coastline around England and Wales, 380 beaches have been identified where bathing waters have been designated under the EC Bathing Waters Directive. This Directive, which was adopted in 1975, was intended to safeguard the quality of waters where bathing is traditionally practised by a large number of bathers, by setting bacteriological and other standards.

The National Rivers Authority's Role

In order to monitor the quality of bathing waters, the National Rivers Authority regularly samples them during the bathing season and assesses the bacterial load against standards set by EC Directives. These data are made available to local Authorities and the public so that they are aware of the current state of bathing waters along the length of the coastline which is of interest to them. A minimum of 20 samples are taken for bacteriological analysis during the bathing season between May and September from each designated beach.

The European Blue Flag

The Blue Flag is awarded to beaches in the European Community member countries where bathing waters and beaches reach a certain standard of cleanliness and amenity.

The main requirements of the Blue Flag Award are:

(i) Bathing water must meet the requirement of the EC Directive on bathing waters.

(ii) There must be an absence of litter both on land and in the sea.

(iii) There must be no oil pollution.

(iv) Beaches must be cleaned up after each day.

(v) There must be no unauthorised camping or dumping and there must be safe and adequate access to the beach.

(vi) Dogs must be banned from part of the beach.

In the United Kingdom, the Blue Flag Award is organised by the Tidy Britain Group.

BIOLOGICAL SURVEILLANCE OF RIVERS IN THE NRA, THAMES REGION

The River Thames, its many tributaries and its estuary contain a great diversity of animal and plant life. Biologists working for the National Rivers Authority, Thames Region, survey the diversity of selected groups of aquatic animals living in these rivers to provide information on the quality of the water.

In the freshwater part of the catchment, the diversity of invertebrates living primarily in the bed of the river is assessed. Sampling sites are selected in reaches of the river with fixed objectives for the quality of the water. Attention is also paid to the location of potentially polluting inputs (such as sewage works) and to selecting a site in a 'natural' section of the river. It should have a good diversity of habitat as the latter provides for a potentially high diversity of invertebrates.

Biologists visit each sampling site at least once a year and a sample of the invertebrates living primarily in the bed of the river is obtained using a hand-net. The biologist kicks at the substrate for 3 minutes and then searches all other habitats not sampled by kicking for a further 1 minute. The invertebrates present in the sample are sorted and identified down to invertebrate family level either on the river bank or back in the laboratory. Each family is allocated a score in the range 1-10 on the basis of its tolerance to pollution (1 for the most pollution tolerant and 10 for the most pollution sensitive). The scores for the families present at a site are added together to give a total score (a high score at a site indicates good water quality whereas a low score indicates poor water quality). A mathematical model has been constructed by the Institute of Freshwater Ecology to enable us to predict the biotic score for a given site based on the knowledge of the physical and chemical characteristics of a site and assuming no water pollution. By comparing the observed score determined by sampling with the predicted score for the site generated by the model, we can assess the extent to which the invertebrate diversity is restricted by water pollution. Biotic scores at freshwater biological sampling sites in the Thames Region range from 233 in the River Windrush at New Bridge to <10 in some of our poorest urban rivers.

In the Thames Estuary, both the diversity of invertebrates and the diversity of fish populations are used to indicate water quality. Selected estuary sites, some intertidal and some subtidal are sampled once a quarter. A range of techniques are used to obtain samples. These include the use of a grab deployed from a boat to collect subtidal mud and sand. All the estuary samples are analysed back at the laboratory, the invertebrates present are identified down to species level and their wet weight determined. Over 200 invertebrate species have been identified living on the bed of the estuary. Species diversity is poorest on the middle reaches, a fact which in part reflects the harsh natural environment there with salinity fluctuations making it impossible for many species to survive. Species of oligochaete worms tolerant of organic enrichment represent the majority of the invertebrate biomass in areas receiving large volumes of treated sewage effluent and areas receiving storm discharges of combined rainwater and sewage.

The estuarine fish population is sampled by collecting the fish drawn into the water intakes of power stations on the estuary or by nets deployed from a boat. Evidence has been collected to indicate a temporary reduction in fish species diversity during periods when the concentration of dissolved oxygen in the estuary was low. These infrequent 'low DO' events are caused by the presence of large quantities of organic matter in the water which degrade

using oxygen. Much of this matter is sewage-derived and has found its way into the estuary via storm discharges.

BIOLOGICAL CHARACTERISTICS OF WATER BODIES

All natural waters and a large number of waste waters contain a wide variety of living organisms and a clean surface water supports a complex ecosystem.

The organisms in such an ecosystem are either autotrophic or heterotrophic. The former utilise solar or chemical energy to fix inorganic materials into complex life molecules. Algae are typical autotrophic organisms. These organisms, that utilise solar energy to synthesise organic materials, are referred to as producers.

Heterotrophic organisms utilise the organic substances produced by autotrophic organisms as energy sources and as the raw materials for production of their own biomass. There is a sub-class of heterotrophic organisms known as decomposers or reducers, consisting mainly of fungi and bacteria which break down material of biological origin to the simple inorganic compounds which are fixed by the autotrophic organisms.

The productivity of a body of water is its ability to produce living material and it depends on the waters physical and chemical characteristics. High productivity is required for fish life. However, if productivity is too high, weeds will grow and choke the watercourse and oxygen levels will be lowered by the dead organic material.

Higher forms of aquatic life, such as fish, form a relatively small part of the biomass and have little effect on aquatic chemistry, although the type and quantity of these higher life forms will be influenced by the properties of the water in which it lives.

The most important physical and chemical properties influencing aquatic life are as follows:

Temperature difference of only a few degrees can result in completely differing forms of aquatic life.

The transparency of water is important in determining growth of algae. Thus turbid water might not allow the production of a biomass even though other conditions (temperature, presence of nutrients, etc) might be ideal.

Water velocity is important for transport of organisms and nutrients and for removal of waste materials. It is also important for transport of oxygen and carbon dioxide across the water-air interface.

Oxygen is undoubtedly the key chemical factor in determining the extent of life in water. Oxygen deficiency is fatal to many forms of aquatic life. Equally, its presence is fatal to anaerobic organisms. Dissolved oxygen is therefore one of the most important factors in determining the biological characteristics of an aquatic body.

Biochemical Oxygen Demand is also important. This is a measure of the oxygen utilised in the biological degradation of organic matter. If a body of water has a high biochemical oxygen demand and a low rate of re-oxygenation, then organisms requiring oxygen will not be sustained.

Carbon dioxide is required for photosynthetic production of algal biomass and

can be a limiting factor. High levels of carbon dioxide produced by organic degradation can result in excessive algal growth.

Nutrients in water also affect the production of aquatic plant life. Adequate supplies of carbon, nitrogen, phosphorus and trace elements are required for plant growth. Phosphorus is often the limiting nutrient and is sometimes controlled in order to limit productivity.

Salinity also determines the kind of aquatic life present. Marine life requires salt water for its existence whereas many freshwater organisms cannot tolerate salt.

RIVER QUALITY OBJECTIVES AND STANDARDS

River Quality Objectives (RQO's) are use-orientated, environmental objectives for freshwater rivers which should be central to a pollution control philosophy. Associated with them are Environmental Quality Standards which are chemical criteria to be achieved if the watercourse is to be suitable for its intended or potential uses, and provide for the most economical use of resources by allowing the quality of effluent discharges to be related to the use of the receiving water.

RQO's can only exist as part of a legislative and technical framework and the new quality criteria are undergoing continual revision particularly as a result of new directives from the European Community.

Objectives

For any large scale pollution abatement scheme the first decision must be to decide "what are we trying to achieve?" This may be simply the prevention of public health nuisance and smell or that the water is suitable for potable abstraction downstream; the scale is very different but the result is the same: an objective has been established. A quality objective defines the use or uses for which a body of water must be suitable. It is convenient to incorporate objectives into a scheme of classification. It is evident that the uses that demand the highest quality will be the determining factor when setting an RQO.

Example:

A lake forms part of a watercourse in an area to be established as a national park. It is not expected to be a salmonid fishery, not to be abstracted for potable supply, but it is of high amenity value. Objective allocated: 1B.

Monitoring RQO Compliance

If the results of biological monitoring can be related to chemical EQS's then they can provide a secondary means of testing compliance with RQO's: a discrepancy between the chemical quality and the biological quality would warrant further investigation (for instance, urban streams tend to have very depressed biota but relatively good chemical quality).

Setting the Standards

The immediate RQO may be simply a statement of the existing quality so that a baseline for improvement is established. It is clear that an understanding of the geography of the catchment and details of the flows and quality experienced need to be taken into account.

To simplify the management of the RQO system, rivers are sub-divided into reaches and each reach would be allocated its own RQO. Each reach would generally be defined at its upstream end by a measurable quality change attribute either to a major discharge of effluent, or to the confluence with a tributary. The RQO needs to be consistent with that of the downstream reach and so their allocation will tend to be 'driven' from the bottom of the catchment upstream.

Where major improvements are planned it may be appropriate to set objectives that will change with time (a timescale may or may not be specified). For

example:- Objective in 1992 - 3, achieve 2B by 1995 and 2A by 1999. In this way improvements brought about by capital works are phased-in with the better quality required.

Having decided what quality objective should be applied in the river, calculations can be made of what loads of various types of polluting matter may be discharged without the EQS's being exceeded. Calculation can be simply arithmetic (e.g. mass balance) using the minimum flow and quality upstream, or a more complex modelling exercise according to needs. Whichever approach is taken the accuracy of the result will reflect the amount of background information available.

The parameters of biochemical oxygen demand, ammoniacal nitrogen and dissolved oxygen are usually expressed as 95th percentile values (i.e. 95% of samples are to have values below this limit). This acknowledges the inherent variability of river systems and assumes a normal distribution for the sample data. Expressing the limit as a percentile rather than an absolute value has been found to be a very satisfactory approach and is also applied to discharge standards. It therefore follows that, for a simple case, the discharge quality should be adequate to maintain the RQO under the adverse conditions of, say, low flow and high temperatures, that occur for 5% of the time. Depending on the local conditions and the type of plant installed it may be possible to have flow-related or seasonal conditions that permit a poorer quality of effluent to be discharged when the available dilution is large and the RQO can be maintained. The ultimate extension of this approach is to have a continuously variable discharge standard related to the receiving water quality and flow. The NRA is continuing to evaluate such a system but it could only be applied to large highly controlled treatment plants. However, considerable savings on treatment costs may be possible.

The objectives may either be long-term or short-term where improvements are anticipated in the near future, and it is fundamental to their use that both the objectives and discharge standards within a catchment are periodically reviewed.

Class 1A - High quality waters

1. Suitable for potable supply at defined abstraction points, and

2. Suitable for all other abstractions, and

3. Suitable for game or other high class fisheries (complying with the requirements of Directive 78/659/EEC for salmonid waters), and

4. Of high amenity value.

Class 1B - High quality waters

1. Used for the transport of high proportions of sewage effluent, trade effluent or urban run-off, and

2. Suitable for potable supply at defined abstraction points, and

3. Suitable for all other abstractions, and

4. Suitable for game or other high class fisheries (complying with the requirements of Directive 78/659/EEC for salmonid waters), and

5. Of high amenity value.

Class 2A - Fair quality waters

1. Suitable for potable supply after advanced treatment at defined abstraction points, and

2. Suitable for agricultural uses, and

3. Capable of supporting good coarse fisheries (complying with Directive 78/659/EEC for cyprinid waters), and

4. Of moderate amenity value.

Class 2B - Fair quality waters

1. Suitable for potable supply after advanced treatment at defined abstraction points, and

2. Suitable for agricultural uses, and

3. Capable of supporting reasonably good coarse fisheries, and

4. Of moderate amenity value.

Class 3 - Poor quality waters

1. Suitable for low grade industrial use, and

2. Not anaerobic or likely to cause a nuisance, and

3. Capable of supporting a restricted aquatic flora and fauna.

N.B. Not required to be capable of supporting a viable fishery.

Class 4 - Bad quality waters

1. Likely to cause a nuisance.

2. Flora and fauna absent or restricted to pollution tolerant organisms.

Class X - Insignificant watercourses

1. Watercourses, not usable, and not placed in classes 1A to 4 above.

2. Capable of supporting a restricted flora and fauna, and

3. Not likely to cause a nuisance.

ENVIRONMENTAL QUALITY STANDARDS

Having established the principle of the quality objective, the next stage is to group together the chemical criteria (environmental quality standard or EQS) which must be met if the objectives are to be fulfilled. These criteria are not intended to be an exhaustive list but are the parameters known to be environmentally important. If additional standards are found to be necessary in order to realise objectives then they can easily be added to the list.

Many of these quality standards derive from the statutory requirements of the European Community legislation. As more and more substances become the subject of daughter directives of the Dangerous Substances Directive the range of parameters will grow. However, much was achieved by the Thames Region of the NRA and its predecessors using the basic parameters of biochemical oxygen demand, ammoniacal nitrogen and dissolved oxygen, since these are of most interest when designing and building plants to purify a previously untreated discharge of sewage. Control of the List I and II substances is usually best achieved by limiting the quantities discharged into the sewers (if domestic and trade wastes are to be co-treated) rather than expensive treatment at the sewage works.

Having established an RQO for a river or part of a river then the classification has a number of advantages:

1. It provides a background against which to judge the results of monitoring.

2. It provides the layman with a more easily understood indication of the regulatory organisation's performance.

3. It can be used to identify where and to what extent investment is needed and so establish priorities.

4. It provides a sound basis for the calculation of discharge quality standards.

CONSENTING

The current method of controlling discharges by "consent" was first introduced by the Rivers (Prevention of Pollution) Act 1951. This allowed control of new discharges of sewage and trade effluent to a stream, river or inland water. Discharges existing prior to 1951 and new discharges to tidal waters were brought under control by the Rivers (Prevention of Pollution) Act 1961, and discharges to underground strata were controlled by the Water Resources Act 1963. In 1985 the Control of Pollution Act 1974 replaced most of the existing provisions regarding discharges to inland and estuarial waters and in 1989 this was superseded by the Water Act 1989. The consolidating Act is the Water Resources Act 1991.

Among the offences under the Water Resources Act 1991 is that of allowing "any poisonous, noxious or polluting matter or any solid waste matter to enter any 'controlled water' (e.g. rivers, groundwaters, coastal waters and certain lakes and ponds)". However, a person shall not be guilty of such an offence providing the discharge is being made in accordance with a consent under the Water Resources Act 1991, the Water Act 1989 or Part II of the Control of Pollution Act 1974.

It is the duty of the National Rivers Authority to determine an application for consent, either unconditionally, subject to conditions or to refuse it. Conditions may be imposed as the NRA thinks fit and can include conditions as to the nature, origin, composition, temperature, volume and rate of discharge, the place of discharge, sampling facilities, meters for measuring the volume etc and any records that the Authority may wish the discharger to maintain.

In order to encourage public participation in the determination of consent applications, significant discharges are advertised in local newspapers and the London Gazette. Members of the public may object to an application, and any objections must be considered by the NRA.

The conditions imposed on a consent are arrived at after considering the River Quality Objective of the receiving watercourse. The standards are set taking into consideration the dilution and other nearby discharges or abstractions.

Computer models are used to calculate concentration limits for discharge consents. Models are useful for complicated river systems and estuaries where there is more than one discharge having an effect and other factors may be involved such as abstraction of water.

There is a right of appeal to the Secretary of State for the Environment for those people that made representations against the discharge if they feel that the discharge should not have been allowed or the standards are not adequate and similarly the discharger may appeal against conditions imposed within the consent if it is felt they are too stringent.

Failure to comply with the consent conditions is an offence. Compliance is monitored by analysis of samples of the effluent. The frequency of sampling depends on the significance of the discharge. The results of the analysis are held on a register which is open to the public. Also held on the register are details of consent applications and consents.